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ABSTRACT

An analysis of portions of the HumRRO (Human Resources Research Organization) developed computer-assisted instruction (CAI) course in COBOL programing, and a survey of representatives from Advanced Research Project Agency (ARPA) PLATO IV installations indicated a need for authoring aids that could be prepared and programed easily and quickly. The nine MONIFORMS resulting from this study are useful for rapid development of certain frequently used CAI material. These authoring aids are partially precoded formats which make use of HumRRO subroutines for question execution. MONIFORMS are used for development of single questions--of the multiple choice, constructed response, and matching type--that can be combined with material prepared by conventional methods. The characteristics of these MONIFORMS are described together with comments on future developments to be made in CAI material generation for military training. (Author/DGC)

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MONIFORMS as Authoring Aids For the PLATO IV CAI System

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May 1975

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An analysis of portions of the HumRRO-developed computer-administered instruction (CAI) course in COBOL Programming, and a survey of representatives from Advanced Research Project Agency (ARPA) PLATO IV installations indicated a need for authoring aids that could be prepared and programmed easily and quickly. The nine MONIFORMS resulting from this study are useful for rapid development of certain frequently used CAI material.

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These authoring aids are partially precoded formats which make use of HumRRO subroutines for question execution. MONIFORMS are used for development of single questions--of the multiple choice, constructed response, and matching type--that can be combined with material prepared by conventional methods. They are responsive to users' needs, cover most of the frequently used question types, reduce preparation time, do not require TUTOR programming experience for their completion, combine readily with conventionally coded material, and are economical with author-computer lesson space. Future MONIFORM activity will include increasing their number and variety, and developing a second generation type MONIFORM.

BACKGROUND

There is increasing evidence that computer-administered instruction (CAI) is a promising approach to meet the new training problems posed by a smaller, all-volunteer Army. CAI, however, is an expensive training medium in terms of inputting quality instructional material into the system, from both the standpoint of time and requirements for programming skill.

This report documents research conducted under Work Unit CATALIST in developing authoring aids (MONIFORMS) for preparation of frequently-used question types in CAI lesson material for the PLATO IV CAI system. These authoring aids greatly reduce the time required for question preparation and require no knowledge of the TUTOR programming language.

PRODUCTS

Nine MONIFORMS have been completed and are presently in use by military and civilian PLATO authors for developing multiple choice, constructed response, and matching-type questions. Essentially, MONIFORMS are partially precoded formats which make use of HumRRO subroutines for question execution. Authors provide only textual material and feedback messages for their questions, and information about the way they wish a student's response to the question analyzed. A typical question can be developed in 10-15 minutes using a MONIFORM, compared to 2-6 hours using conventional methods of preparation. MONIFORMS are used for the development of single questions that can be combined with material prepared by conventional methods. Therefore, MONIFORMS do not dictate the overall structure of an author's lesson.

An introduction and guide to the use of MONIFORMS (Lesson MONIFORM) are available, in a CAI version on the PLATO system and in a programmed text version, for use by any interested author.[1]

IMPLICATIONS

It has been demonstrated that the nine available MONIFORMS are useful tools for rapid development of certain frequently used CAI material. There is a need for continuing activity in MONIFORM development in the following areas:

(1) To increase the catalog of MONIFORMS to include other question types and alternate means of accepting students' responses.

(2) To develop MONIFORM data collection packages.

(3) To increase the length of feedback messages permitted.

(4) To develop a second generation type MONIFORM in which PLATO requests information from the author that can be automatically converted to executable code.

[1] Russel E. Schulz. *Lesson MONIFORM, An Authoring Aid for the PLATO IV CAI System*, HumRRO Research Product RP-ED-75-6, April 1975.

PREFACE

This report describes the development of Work Unit CATALIST authoring aids (MONIFORMS) for the PLATO IV computer-administered instruction (CAI) system. The research objectives, procedure, results, and implications for further research are discussed. A companion document, *Lesson MONIFORM, An Authoring Aid for the PLATO IV CAI System*, HumRRO Research Product RP-ED-75-6, provides descriptions of developed MONIFORMS and detailed guidance to users for MONIFORM completion.

The work was conducted at HumRRO Eastern Division, Alexandria, Virginia, Dr. J. Daniel Lyons, Director. Dr. Robert J. Seidel is the Program Director for Work Unit CATALIST. Mr. Russel E. Schulz is primarily responsible for the MONIFORMS research. Assistance was provided by HumRRO researchers Dr. Harold Wagner, Michael Hillelsohn, Richard Rosenblatt, Nancy Hibbits, Carol Kastner, Judith Compton, Theodore Rosen, William Underhill, Patricia Hasty, and SP/4 John Volk.

Appreciation is extended to individuals at the various Advanced Research Project Agency (ARPA) PLATO installation sites for survey information provided and for their interest in MONIFORM development. Also, individuals at the University of Illinois Computer-Based Educational Research Laboratory, and especially H.A. Himwich and Dr. L.D. Francis, provided invaluable assistance in the development of individual MONIFORMS.

HumRRO research for the Department of the Army under Work Unit CATALIST is performed under Army Contract DAHC19-73-C-0004. Computer-administered instruction research is conducted under Army Project 2Q763731A734. The CATALIST work is conducted under the sponsorship of the U.S. Army Research Institute for the Behavioral and Social Sciences, with Dr. Joseph S. Ward serving as the technical monitor.

Meredith P. Crawford
President
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MONIFORMS as Authoring Aids For the PLATO IV CAI System

INTRODUCTION

BACKGROUND

The combination of shrinking financial resources and the prospects of a smaller, all-volunteer Army will increase the demands made on Army personnel and the importance of the individual soldier. There will be a greater need for more effective and efficient training, adequate to the task of providing an increasing number of complex skills to widely differing students, with fewer skilled instructors.

There is mounting evidence that computer-administered instruction (CAI) is the most promising approach available to meet these new training demands.

The HumRRO Instructional Technology Group (ITG) has been active in CAI research and development since 1968. (See Appendix A.) MONIFORMS (Monitoring Formats) are designed for use on the PLATO IV CAI system and represent HumRRO's continuing research effort to develop advanced authoring aids.

PROBLEM

The development of quality instructional materials is a major cost that must be considered when implementing any CAI system. Obviously, the quality of instruction received by a CAI student will depend primarily upon the quality of the instructional material inputted into the computer. Further, the preparation of quality material requires considerable time and skill. Both of these factors are frequently in short supply at many CAI installations.

The PLATO IV CAI system is a highly sophisticated system that permits greater innovative freedom in the instructional methodology used than do many other CAI systems. Because of its sophistication, the quality of instruction that may be presented on PLATO IV is limited only by the imagination and skill of the individual author and/or TUTOR programmer. This greater freedom, however, frequently results in increasing the cost of producing instructional material. That is, the cost in terms of time and skill requirements is generally positively related to the complexity and sophistication of the instructional material being prepared.

Therefore, an important goal for CAI research is to find ways in which the authoring and programming processes can be accomplished more easily and quickly while a high quality of instruction is maintained. The development of effective authoring aids can make a significant contribution to the accomplishment of this goal. The HumRRO-developed MONIFORMS are one type of authoring aid that holds considerable promise. Essentially, MONIFORMS are partially precoded formats. They are designed to assist in the preparation of certain types of instructional material for monitoring student performance and to provide immediate assistance to students whose performance is found to be deficient.

STAFF TRAINING

In preparation for the development of MONIFORMS, three scientists from the ITG visited the University of Illinois Computer-Based Educational Research Laboratory

(CERL) for a one-week training program in the TUTOR programming language. The MONIFORM project leader remained at CERL for an additional month of advanced on-the-job-training. Upon his return from CERL, an off-line TUTOR training program was prepared and administered to the remaining ITG staff.[1] This training was initially administered off-line since the delivery of the PLATO IV terminals to HumRRO was greatly delayed, and the research time schedule did not permit waiting for their arrival for the staff to begin training.

RESEARCH OBJECTIVES

Six major objectives were established for the development of MONIFORMS:

(1) MONIFORMS must be responsive to the needs of PLATO IV users, especially those at military CAI installations.

(2) MONIFORMS must be prepared only for frequently used types of instruction in which the basic code is essentially the same, independent of the external characteristics of the material. For example, the code necessary for any multiple choice question is basically the same, independent of such variables as the textual content, number of answer alternatives, feedback messages, and placement on the screen.

(3) MONIFORMS must permit significantly more rapid preparation of instructional material than do conventional methods of preparation.

(4) MONIFORMS must be usable to authors and programmers with limited experience with the PLATO IV system and the TUTOR programming language, as well as to the more experienced author and programmer.

(5) MONIFORMS must have the capability of producing material that can be combined with material prepared without MONIFORMS. It is unlikely that MONIFORMS meeting all authors' total requirements could ever be developed. Therefore, the total instructional package should have production capabilities with material prepared with both MONIFORMS and conventional methods.

(6) MONIFORMS must be economical with the author's computer lesson space.

[1] Selected individuals from the ITG staff were later used to compare the preparation time required for material prepared with and without MONIFORMS. Training consisted of a series of practice problems similar to those used at CERL. While these problems were designed to fulfill specific ITG staff training requirements, they are available to other interested individuals upon request.

PROCEDURE

IDENTIFICATION OF MATERIAL SUITABLE FOR MONIFORMS

As a first approach to identifying material that would lend itself to MONIFORM preparation, selected portions of the HumRRO-developed CAI course in COBOL Programming[1] were carefully screened and each question contained in the material was displayed on flow charts. The flow charts showed that from approximately 200 different questions, all could be prepared with approximately 15 different coding formats. Furthermore, the number of question types that could be handled by the same basic programming code, and the frequency of their use, were sufficient to justify the development of MONIFORMS to assist in the preparation of similar types of questions. From the screening, an initial list of question types that would lend themselves to MONIFORMS was prepared. These were multiple choice, constructed response, and matching-type questions.

To ensure that the approach was responsive to PLATO military users' needs, a survey was conducted in January 1974, of representatives from Advanced Research Project Agency (ARPA) PLATO IV installations. In some cases, installations duplicated the survey form and had more than one member of their staff complete a form. Twelve installations were represented in the survey. From these installations, 16 survey forms were returned.

The survey results support the need for MONIFORMS of the type established in the screening of the HumRRO COBOL CAI program and provide information about military authors and programmers useful in MONIFORM development.

Appendix B shows the ARPA installations surveyed; and Appendix C shows the tabulated survey responses for questions of concern to this study. Four of the installations surveyed did not have PLATO terminals and therefore returned the survey unanswered. Some individuals did not complete every question. Therefore, the number (N) for each question ranged from 7-12. Admittedly, this is a small N, but the data do provide useful information. The results can be summarized as follows:

(1) A period of 20 weeks was the mean number of weeks of experience with the PLATO system that the average author required in order to take advantage of most of the capabilities of the system. This is a considerable expense. Authoring aids, which require less TUTOR programming experience, can help to reduce this expense.

(2) Eight of ten individuals responding to the applicable question reported that 75-100% of the coding commands necessary for on-line implementation of CAI material is coded by the authors themselves.

(3) Ten of the twelve individuals responding reported they make extensive use of practice questions as a means of monitoring and shaping student performance. Multiple choice questions were reported as the most frequently used type of question for this purpose (62%).

(4) Almost all respondents reported that available time and TUTOR programming experience seriously affect the number and complexity of practice questions

[1]The COBOL2 course developed by HumRRO under Work Unit IMPACT/CATALIST consists of microfiche that contains text, one student reference manual (125 pages), and a 35mm film strip of auxiliary visuals.

and response analysis strategies prepared at their installations. Effective authoring aids can reduce the time required for preparation of routine questions and should therefore provide additional preparation time for more complex questions and/or time for studying TUTOR programming.

(5) Authoring aids would be most useful for the preparation of multiple choice questions, followed by constructed response and matching-type questions.

MONIFORM DEVELOPMENT

The typical steps taken in the development of each MONIFORM were as follows:

(1) Initial listing of characteristics thought to be desirable for the question type under consideration. (What should the final MONIFORM do?)
(2) Review of these characteristics, and decision as to feasibility of inclusion in the MONIFORM.
(3) Finalizing the list of characteristics.
(4) Preparation of a working copy flow chart for the response analysis capabilities of the question type.
(5) Examination of subroutines used in previous MONIFORMS to determine their applicability in the MONIFORM under development.
(6) Preparation of initial TUTOR coding for the MONIFORM.
(7) Testing and revision of initial coding for proper question execution.
(8) Decision as to which portion of the initial coding should be included in the MONIFORM and which portion should be included in HumRRO subroutines.
(9) Preparation of instructions for user completion of the MONIFORM.
(10) Tryout of MONIFORM for question preparation by selected members of the CATALIST staff.
(11) Revision of code and instructions as necessary.
(12) Release of the MONIFORM to the general PLATO audience.
(13) On-site interviews of MONIFORM users for their reactions, criticisms, and needs.
(14) Refinement of the MONIFORM.

Nine MONIFORMS were developed and introduced to military and civilian PLATO users by means of the on-line PLATO communication system, "Lesson NOTES," and "Lesson arpafile."[1]

Four of these MONIFORMS are used for preparation of multiple choice questions, three for preparation of constructed response questions, and two are used for preparation of matching-type questions. All of the MONIFORMS offer the user considerable freedom to individualize his particular questions both in textual content and in methods for analyzing students' responses. For example, all of the MONIFORMS allow the author to specify the number of attempts the student will be permitted to answer the questions and which one of three types of assistance the student will receive when the attempt limit is reached. In two of the multiple choice MONIFORMS, answer alternatives are presented in random order and therefore provide an unbiased method of ordering answer alternatives.

All nine MONIFORMS provide for author specified feedback messages. In some MONIFORMS the incorrect answer feedbacks may be written to deal with specific incorrect answers (response specific feedbacks), whereas in others, the incorrect answer

[1] Arpafile is a lesson designed for ARPA users for documenting material of potential interest to other ARPA users.

feedbacks are more general in nature but may differ, depending upon the particular student attempt (general feedbacks).

Tables 1-9 give a brief description of the nine MONIFORMS.[1]

Table 10 is an example of an uncompleted MONIFORM used for preparation of constructed response questions in which the user may provide feedback messages for (a) a correct answer, (b) anticipated wrong answers, or (c) unanticipated wrong answers. (See Table 7 for complete characteristics.) To use this MONIFORM an author would use the copy feature of the PLATO system to copy the MONIFORM into his lesson space. He would then follow the instructions that appear in the MONIFORM after the double dollar signs ($$) to tailor the question to his specific requirements.[2] Table 11 shows the same MONIFORM as in Table 10, except that the MONIFORM is now completed to show a sample question.

Approximately 80-90% of the TUTOR code (subroutines) necessary for execution of questions prepared with MONIFORMS resides in HumRRO lesson space and is available to all users for execution of all MONIFORMS. An author never copies this code into his lesson space. To use the code, the author copies unit "setup," shown in Table 12, into his lesson one time only regardless of the number or type of MONIFORMS used. Therefore, the only TUTOR code associated with a question prepared with MONIFORMS that resides in the author's lesson space is unit "setup" (one time only) and the completed MONIFORM.

LESSON MONIFORM

As each MONIFORM was developed, it was immediately made available to all PLATO authors. In order to keep the authors informed of MONIFORM development, a CAI lesson, lesson MONIFORM, was prepared. It has undergone three revisions. Readers who have a PLATO terminal available are encouraged to examine this lesson.[3] It is designed so that users have maximum freedom in branching to various subjects within the lesson. As a consequence, they need access only those sections for which they want specific information. A brief description of each of the sections in the lesson is shown in Appendix D.

The CAI version of Lesson MONIFORM is useful if the author has a PLATO terminal immediately available. However, some users of MONIFORMS may want to study MONIFORM use away from the terminal. For this reason, Lesson MONIFORM is also available in a hard-copy programmed text version.[4] Also, while in the process of completing a MONIFORM, a user may find it more convenient to refer to the programmed text rather than the CAI version. The two versions therefore offer the user a choice of which he prefers to use. However, after an author has successfully completed a MONIFORM, he will probably require little assistance from the lesson for completion of successive MONIFORMS.

[1] A more complete description of HumRRO MONIFORMS is given in *Lesson MONIFORM, An Authoring Aid for the PLATO IV CAI System*, by Russel E. Schulz, HumRRO Research Product RP-ED-75-6, April 1975. The reader may also refer to Lesson "moniform" on-line on the PLATO system.

[2] Coding details are described in *Lesson MONIFORM, An Authoring Aid for the PLATO IV CAI System*. (See previous footnote.)

[3] Sign into PLATO lesson moniform as a student.

[4] See HumRRO Research Product *Lesson MONIFORMS, An Authoring Aid for the PLATO IV CAI System*, by Russel F. Schulz, Research Product RP-ED-75-6, April 1975.

Table 1

MONIFORM1 CHARACTERISTICS
(Multiple Choice)

1 correct answer (40 characters long)
1-4 distractors (40 characters long)
Answer alternatives presented in random order
Option of having student's response judged immediately after he/she has entered it, or requiring the student to press the NEXT key before judging begins
Author specified number of attempts student is allowed
1 author specified correct answer feedback
1-4 author specified general feedbacks
Unanticipated response feedback
Author specifies type of assistance student receives when try limit reached (instructor is called, answer is given, or no assistance is given)
2 author specified branching units

Table 2

MONIFORM2 CHARACTERISTICS
(Multiple Choice)

All characteristics are identical to MONIFORM1 except:

MONIFORM1—answer alternatives presented in random order

MONIFORM2—answer presented in order specified by author

Table 3

MONIFORM3 CHARACTERISTICS (Multiple Choice)

1 correct answer (40 characters long)

1-4 distractors (40 characters long)

Answer alternatives presented in random order

Option of having student's response judged immediately after he/she has entered it, or requiring the student to press the NEXT key before judging begins

Author specified number of attempts student is allowed

1 author specified correct answer feedback

1-5 response specific incorrect answer try again feedbacks

Unanticipated response feedback

Author specifies type of assistance student receives when try limit reached (instructor is called, answer is given, or no assistance is given)

2 author specified branching units

Table 4

MONIFORM4 CHARACTERISTICS (Multiple Choice)

All characteristics are identical to MONIFORM3 except:

MONIFORM3—answer alternatives presented in random order

MONIFORM4—answer alternatives presented in order specified by author

Table 5

MONIFORM5 CHARACTERISTICS (Constructed Response)

Synonymous answers (or phrases) permitted
Optional words permitted in answer
Author selected specification for judging of student answer using the TUTOR-specs-command
1 author specified correct answer feedback
Author specified number of attempts student permitted
1-4 author specified general (not response specific) incorrect answer try again feedbacks
Unanticipated response feedback
Author specified type of assistance student receives when try limit reached (instructor is called, answer is given, or no assistance is given)
2 author specified branching units

Table 6

MONIFORM6 CHARACTERISTICS (Constructed Response)

Synonymous answers (or phrases) permitted
Optional words permitted in answer
Author selected specification for judging of student answer using the TUTOR-specs-command
1 author specified correct answer feedback
1-5 response specific incorrect answer try again feedbacks
1 general incorrect answer try again feedback
Author specified number of attempts student permitted
Unanticipated response feedback
Author specified type of assistance student receives when try limit reached (instructor is called, answer is given, or no assistance is given)
2 author specified branching units

Table 7

MONIFORM7 CHARACTERISTICS
(Constructed Response)

MONIFORM7 is a combination of MONIFORM5 and MONIFORM6. That is, in MONIFORM5 only "general" feedbacks (not response specific) are presented to the student for incorrect answers; in MONIFORM6 response specific feedbacks are given.

MONIFORM7 provides the student with both "general" and "response specific" feedbacks.

Table 8

MONIFORM8 CHARACTERISTICS
(Matching)

Maximum of 9 matching items permitted

Matching answer alternatives presented in random order

Student moves pointer to select match

After completing all matches, student given opportunity to change answers

Number of attempts at entire problem specified by author

MONIFORM provided feedback stating number of correct matches made on each attempt

Author specified correct answer feedback

Author specified type of assistance student receives when try limit reached (instructor is called, answer is given, or no assistance is given)

Table 9

MONIFORM9 CHARACTERISTICS
(Matching)

Maximum of 10 matching items permitted (order specified by author)
Single, double, or triple spacing permitted between matching items
Graphic displays may be incorporated into matching problem
Student permitted to match items in any order desired
Student permitted to change answers before final judging
Number of attempts at entire problem specified by author
Author specified correct answer feedback
Student informed of specific incorrect matches made
Author specified type of assistance student receives when try limit reached (instructor is called, answer is given, or no assistance is given)

Table 10

MONIFORM7 (Uncompleted) Constructed Response

```
unit      form7                  $$ r form7 with your unit name
next      nextu                  $$ r nextu with your next unit
define    form1                  $$ copy as is
zero      v(offset),88           $$ copy as is
calc      pos⇦                   $$ add screen position to start
write     <at,pos>               $$ add line 1 of question
          $$                     $$ r first $$ with line 2 of question
          $$                     $$ r first $$ with line 3 of question
          $$                     $$ r first $$ with line 4 of question
calc      lines⇦                 $$ add # question lines used
vocabs    form7                  $$ r form7 with your unit name
          <zz,zz,zz>             $$ r zz's with optional words
          (catext,zzzz)          $$ r zz's with correct answer
          (alt1,wrong1)          $$ r wrong 1 with incorrect answer 1
          (alt2,wrong2)          $$ r wrong 2 with incorrect answer 2
          (alt3,wrong3)          $$ r wrong 3 with incorrect answer 3)
          (alt4,wrong4)          $$ r wrong 4 with incorrect answer 4
          (alt5,wrong5)          $$ r wrong 5 with incorrect answer 5
pack      temp,catext,           $$ add correct answer (one only)
pack      temp,caf,              $$ add correct answer feedback
pack      temp,taf,              $$ add feedback for wrong answer 1
pack      temp,taf2,             $$ add feedback for wrong answer 2
pack      temp,taf3,             $$ add feedback for wrong answer 3
pack      temp,taf4,             $$ add feedback for wrong answer 4
pack      temp,taf5,             $$ add feedback for wrong answer 5
pack      temp,waf,              $$ add general feedback 1
pack      temp,waf2,             $$ add general feedback 2
pack      temp,waf3,             $$ add general feedback 3
pack      temp,waf4,             $$ add general feedback 4
calc      ntaf⇦                  $$ add # of general fdbacks used
          notries⇦               $$ add # attempts student permitted
          assist⇦                $$ add: instr—for instructor assistance OR
                                 $$ add: answer—correct answer given OR none
          pos⇦pos+(lines x 100)  $$ copy as is
arrow     pos+200                $$ copy as is
specs     $$                     $$ r first $$ with desired specs
join      drive16                $$ copy as is
nextnow remed=0,x,otheru,        $$ r otheru with name remed unit
goto      ansok,drive14,drive18,       $$ copy as is
concept catext                   $$ copy as is
concept alt1                     $$ copy as is (delete if not used)
concept alt2                     $$ copy as is (delete if not used)
concept alt3                     $$ copy as is (delete if not used)
concept alt4                     $$ copy as is (delete if not used)
concept alt5                     $$ copy as is (delete if not used)
```

Table 11

MONIFORM7 (Completed) Constructed Response

```
unit      yrname
define    form1
zero      v(offset),79
calc      pos ⇦ 2210
vocabs    yrname
          <it,is,it7s,the,state,of>
          (catext,delaware,del,de)
          (alt1,pa,pennsylvania)
          (alt2,nj,new*jersey)
          (alt3,ny,new*york)
          (alt4,va,virginia)
          (alt5,md,maryland)
write     ⟨at,pos⟩ What was the first state to join the U.S.?
calc      lines ⇦ 1
pack      temp,catext,Delaware
pack      temp,caf,A small but powerful state.
pack      temp,taf,They were second in the Union.
pack      temp,taf2,That's known as the Garden State.
pack      temp,taf3,The Empire State could not be first.
pack      temp,taf4,Virginia is for lovers.
pack      temp,taf5,Spiro's home doesn't make it.
pack      temp,waf,It's located in the East on the ocean.
pack      temp,waf2,It's the second smallest state.
pack      temp,waf3,It has a river named after it.
pack      temp,waf4,It's between Pa,NJ, and Md.
calc      notries ⇦ 6
          ntaf ⇦ 4
          assist ⇦ instr
          pos ⇦ pos+(linesx100)
arrow     pos+200
specs     nomark,bumpshift
join      drive16
nextnow   remed=0,x,review,
goto      ansok,drive14,drive18,
concept   catext
concept   alt1
concept   alt2
concept   alt3
concept   alt4
concept   alt5
```

Table 12

Unit Setup

```
unit        setup
define      form2
            offset = 5Ø          $$ you may specify another number
jump        form                 $$ r form with name of your 1st unit
use         hum9,definea         $$ used with all moniforms
*NOTICE:  Place a star (*) in front of any -use- statement,
*below, not necessary for execution of the MONIFORM(S)
*you are using in your lesson.  This will save you ecs.
*(Do not delete since you may use them in later MONIFORMS.)
use         drivea               $$ used with moniforms1,2,3,4,5,6,7,9
use         driveb               $$ used with moniforms1,2,3,4,5,6,7
use         drivec               $$ used only with moniform8
use         drived               $$ used only with moniform8
use         drivee               $$ used only with moniforms8 and 9
use         drivef               $$ used only with moniform9
```

RESULTS

In general, MONIFORMS have met the objectives successfully. The following discussion covers the six objectives listed earlier in this report.

1. MONIFORMS are responsive to users' needs. Examination of lessons prepared by ARPA users employing conventional means shows several examples of material that could have been prepared more easily and quickly by using MONIFORMS. Unfortunately, much of the lesson material prepared at ARPA PLATO installations had already been written and coded prior to the availability of MONIFORMS. As a consequence, MONIFORMS have received only limited use at ARPA PLATO sites. However, almost all of the ARPA sites have expressed considerable interest in using MONIFORMS for future lesson development. Precise data concerning the use of MONIFORMS by the general PLATO audience are not available. It is known, however, that several PLATO sites have used MONIFORMS. To date, Lesson MONIFORM had been accessed 396 times. In several cases the lesson has been accessed by the same individuals more than once, which indicates more than a passing interest in MONIFORMS and their use.

2. MONIFORMS cover the majority of frequently used question types. Examination of a considerable amount of PLATO lesson material demonstrates that multiple choice, constructed response, and matching-type questions represent a significant amount of the lesson material prepared for the PLATO system. MONIFORMS are very useful for these types of questions because they offer the user considerable freedom in structuring his questions and response analysis to meet his particular requirements.

3. MONIFORMS greatly reduce question preparation time. There is no doubt that instruction covered by MONIFORMS can be coded into the PLATO system more quickly by using MONIFORMS than by using conventional methods. The average inexperienced author can code a question with any MONIFORM in approximately 10 minutes or less. The time required to code a question by conventional methods would depend upon the type of question to be coded. A multiple choice question where answer alternatives were presented in random order took three HumRRO researchers with one month of TUTOR programming experience 2-5 hours to code by conventional methods. It required only 7-12 minutes for them to code the same question using a MONIFORM.

Specific data for conventional coding of constructed response and matching questions were not collected because these are more difficult types of questions to code. Thus, the time required for coding would be greater than the 2-5 hours required for the multiple choice question. As a matter of fact, it is likely that the inexperienced author would be unable to code the matching-type questions without considerable assistance. Even for the experienced author it would require 4 or more hours to code the matching questions by conventional methods as compared to 10 minutes by MONIFORM. Therefore, using MONIFORMS can greatly reduce question preparation time for both experienced and inexperienced authors.

4. TUTOR programming experience is not required for completion of MONIFORMS. Knowledge of TUTOR programming is not needed for MONIFORM completion. The user needs to know only basic PLATO editing commands such as "copy," "replace," and "insert," to complete any MONIFORM. PLATO editing skills sufficient to permit an author to complete any MONIFORM can be acquired within a few minutes. For example, the author of this report has observed individuals, who had previously not seen the PLATO terminal and had no TUTOR programming knowledge, complete MONIFORMS within 20 minutes.

The fact that TUTOR programming experience is not required for MONIFORM completion may have considerable significance in cases where a team approach is used for lesson development. In these cases an author might prepare his questions on paper and have a secretary input them into the computer. Also, with the team approach, the number of skilled TUTOR programmers necessary can probably be reduced if MONIFORMS are used. Since material covered by MONIFORMS can be coded by unskilled personnel there would not be the need for as many skilled programmers; or novice programmers could be put to immediate productive use. Skilled programmers could be used only for coding material not covered by MONIFORMS. Eventually this could increase the overall quality of instructional material inasmuch as the skilled programmer would have more time for coding more sophisticated material.

5. Material prepared with MONIFORMS can be combined with conventionally coded material. By design, MONIFORMS are used for creation of independent units of instruction that can be combined with units prepared without MONIFORMS. Therefore, MONIFORMS in no way dictate the overall structure of an author's lesson. He would use MONIFORMS only in those portions of the overall lesson where the material prepared with MONIFORMS meets his instructional objectives. Actually, it is highly recommended that MONIFORMS not be used for the preparation of an entire lesson. At this point, available MONIFORMS cover only relatively simple questions and response analyses. If an entire lesson were composed of this material, it would probably not be interesting for the student and certainly would not take full advantage of the capabilities of the PLATO system.

6. MONIFORMS are economical of author computer lesson space. MONIFORMS are extremely economical of the PLATO lesson space assigned the author. Approximately 80-90% of the TUTOR code (subroutines) necessary for question execution resides in HumRRO lesson space. The subroutines themselves are not resident in the author's lesson space. Also, many of the subroutines are used in several of the MONIFORMS. This, plus the fact that all authors using MONIFORMS are using the same subroutines for question execution, results in a considerable savings in overall computer lesson space requirements.

DISCUSSION

IMPLICATIONS FOR FUTURE RESEARCH

It has been demonstrated that the nine presently available MONIFORMS are valuable tools for rapid development of certain frequently used CAI materials. However, there is a need for continuing activity in MONIFORM development in the following areas:

(1) There are a number of other question types that would lend themselves to MONIFORMS. For example:

(a) Numerical manipulation questions.
(b) Ranking questions.
(c) Multiple choice questions with multiple correct answers.
(d) Multiple choice questions in which the student is branched depending upon the specific response given.
(e) Questions that employ the PLATO touch panel as a means of accepting the student's response.

(2) MONIFORMS presently do not permit on-line collection of data concerning individual performance on specific questions. Therefore, it is difficult to assess the instructional value of material prepared with MONIFORMS, and generally it is not feasible to use MONIFORMS for creation of quiz questions. A data collection package could be developed which authors would have the option of appending to their MONIFORMS. This package would greatly strengthen the value of MONIFORMS at relatively little cost.

(3) In most MONIFORMS the length of feedback messages is limited to 40 characters. User reports indicate longer feedbacks would be desirable. The method has already been developed for permitting authors to have feedbacks of any desired length. Implementation would involve only a small additional effort.

(4) MONIFORMS can be described as a first generation of HumRRO authoring aids for the PLATO IV system. They are partially completed coding formats that the author copies into his lesson and completes to create his individual question. A logical second generation MONIFORM would be an inquiry system of MONIFORMS. Under this system, rather than completing a MONIFORM, PLATO would pose a series of questions to the author concerning the type of question desired, text and feedback messages, and the desired response handling strategy. This type of authoring aid would be more difficult to develop than standard MONIFORMS but would be even easier for the author to complete.

APPENDICES

Appendix A

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Appendix B

PLATO CAI INSTALLATIONS SURVEYED

Behavioral Technology Laboratory, University of Southern California, Los Angeles, California.

USC/Information Science Instruction, Marina Del Ray, California.

Advanced Instructional Systems Directorate, Naval Personnel Research and Development Center, San Diego, California.

Institute for Mathematical Studies in the Social Sciences, Stanford University, Stanford, California.

The Rand Corporation, Santa Monica, California.

Air Force Human Resources Laboratory, Technical Training Division, Lowry AFB, Colorado.

Naval Air Training and Experimental Command (NATEC), Orlando, Florida.

Chanute Technical Training Center, Training Research Applications Branch, Chanute Air Force Base, Illinois.

Department of Educational Psychology, University of Illinois, Urbana, Illinois.

U.S. Army Ordnance Center and School, Aberdeen Proving Ground, Maryland.

Computerized Training System, U.S. Army Signal Center and School, Fort Monmouth, New Jersey.

Air Force Human Research Laboratory, AST, Wright-Patterson AFB, Ohio.

Appendix C

SURVEY RESPONSES

Not all individuals responded to each question. Therefore, the number of individuals (N) responding to the following questions ranges from 7-12. (The N for each question is shown in parentheses.)

Give your best estimate of the number of weeks of experience with the PLATO system that the average author requires in order to take advantage of most of the capabilities of the system. (N=9)

Mean
20 weeks of experience

Approximately what percentage of the coding commands necessary for on-line implementation of your CAI material is typically written by authors (as opposed to separate coders)? (N=10)

Frequency	
3	100%
5	75-99%
0	50-74%
1	25-49%
1	1-24%
0	0%

If authoring and programming are performed by separate individuals in your organization, to what extent is communication between the authors and programmers a problem? (N=12)

Frequency	
5	Not applicable. Authoring and programming are performed by the same individual.
1	Never a problem
4	Sometimes a problem
0	Frequently a problem
2	Very frequently a problem

To what extent do you make use of practice questions in your operations as a means of monitoring and shaping student performance? (N=12)

Frequency	
2	No use
0	Little use
0	Some use
10	Extensive use

Does lack of available time for CAI development seriously affect the number and complexity of practice questions and response analysis strategies prepared at your installation? (N=9)

Frequency	
0	Never
0	Seldom
7	Sometimes
1	Often
1	Very Often

Does lack of CAI authoring or TUTOR programming experience seriously affect the number and complexity of practice questions and response analysis strategies prepared at your installation? (N=10)

Frequency	
0	Never
2	Seldom
5	Sometimes
1	Often
2	Very Often

If practice questions are included in your instructional material, what percent is typically of the following types? (Your total should equal 100%.) (N=7)

Mean (%)	
4	True-False
62	Multiple Choice
8	Matching
2	Ranking Alternatives
10	Constructed Response (Verbal answer)
14	Constructed Response (Numerical answer)

For which types of practice questions would authoring/programming aids be most useful to you? Please rank your order of preference, with "1" being assigned to the question type where authoring/programming aids would be most valuable. (N=8)

Rank	
5	True-False
1	Multiple Choice
3	Matching
4	Ranking Alternatives
2	Constructed Response (Alphanumeric answer)
6	Constructed Response (Numerical answer)

Appendix D

DESCRIPTION OF MAJOR SECTIONS IN LESSON MONIFORM

Lesson MONIFORM is a lesson designed to assist authors in completing MONIFORMS. Two versions of this lesson are available, a CAI version and a programmed text version. Readers are encouraged to examine one or both of these versions.[1]

A brief description of the 11 sections of Lesson MONIFORM follows:

(1) Introduction—Explains how the lesson should be used and gives the rationale for MONIFORM use.

(2) Sample Questions—Contains representative sample questions for each MONIFORM. The questions give the user the opportunity of trying out the response handling capabilities of the MONIFORM.

(3) Completed MONIFORMS—Shows the completed MONIFORM for the sample questions.

(4) Uncompleted MONIFORMS—Are identical to the MONIFORMS the user copies into his lesson.

(5) MONIFORM Characteristics—Describes each MONIFORM to assist the user in deciding if the MONIFORM fills his needs.

(6) How to use MONIFORMS—Describes briefly the six steps necessary for using MONIFORMS.

(7) Unit "setup"—Describes the unit the user copies into his lesson which permits the use of HumRRO code for question execution.

(8) Variables Used—Lists the variables used for each MONIFORM. MONIFORMS use PLATO student variables for storing the author's text and special instructions on how the questions are to be executed. These variables are therefore temporarily reserved for MONIFORM use.

(9) HumRRO Drive Units Used—References the specific code used with each MONIFORM, since, in rare instances, an author may want to copy HumRRO code (drive units) into his lesson.

(10) Assistance With Code Completion—Provides detailed instructions for the completion of each line of code in the MONIFORMS, since the brief instructions contained on the MONIFORM are sometimes insufficient for the inexperienced user.

(11) Debugging Your Question—Contains a list of things to check for if the author's question does not execute correctly.

[1] The CAI version may be examined by signing into PLATO Lesson "moniform." The programmed text version is contained in *Lesson MONIFORM, An Authoring Aid for the PLATO IV CAI System*, by Russel E. Schulz, HumRRO Research Product RP-ED-75-6, April 1975.